

REMARKS

Applicants affirm the election of Group I, claims 1-10, without traverse. Non-elected claims 11-14 have been canceled. Applicants reserve the right to file a divisional application directed to the canceled subject matter. Method claim 15 has been amended to include all of the limitations of claim 1. Applicants respectfully request rejoinder upon allowance of the product claims.

In response to the objection to the specification, most of the errors noted by the Examiner appear to be scanning errors on the part of the USPTO. Applicants submit herewith a Substitute Specification including a redline copy showing the amendments thereto. The Substitute Specification corrects the informalities noted by the Examiner including those at page 11, lines 13 and 14. The Substitute Specification contains no new matter.

Withdrawal of the objection is respectfully requested.

Claims 1-10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,096,411 to Nakatani et al. in view of U.S. Patent No. 4,816,615 to Prabhu et al.

Nakatani et al. was cited as disclosing a printed circuit board comprising an insulating layer, via holes and a conductive paste containing copper particles, liquid epoxy resin (i.e., an organic vehicle) and insulating particles (citing column 3, lines 4-10). The insulating particles are said to include metal oxide particles, glass particles and ceramic particles exemplified by SiO_2 , Al_2O_3 , etc. Although Nakatani et al. is said to be silent with respect to the size of the glass and ceramic particles, the Examiner considered that it would have been a matter of design choice to select insulating particles for the conductive paste having a particle size within the claimed

range. Prabhu et al. was cited as teaching the use of a ceramic layer as an insulating layer in a printed circuit board.

Applicants traverse, and respectfully request the Examiner to reconsider for the following reasons.

(i) The Invention:

A characteristic feature of the present invention as claimed in claims 1, 2 and 3 is that the copper paste (coated on a ceramic green sheet and fired to form a conductor layer and an insulating layer) contains one or both of an SiO₂ particle having an average particle size of 50 nm or less and a ceramic particle having an average particle size of 100 nm or less and which is non-vitrifiable after sintering. In accordance with the invention, the presence of the SiO₂ fine particle, in a debinding process, heightens the firing initiation temperature of the copper powder so as not to advance densification and thereby facilitate the escape of organic components. The SiO₂ fine particle also provides an operational effect of approximating the sintering initiation temperature of copper powder to the sintering initiation temperature of the ceramic green sheet so as to prevent warping or waving of the ceramic substrate. If the average particle size of the SiO₂ fine particle exceeds 50 nm, warping or waving is readily generated on the wiring board and this is not preferred (page 6, line 24-page 7, line 24 of the specification).

Also in accordance with the present invention, in the copper paste containing a ceramic particle having an average particle size of 100 nm or less and which is non-vitrifiable after sintering, when coated on a ceramic green sheet and fired, glass is prevented from surfacing in the conductor layer thus formed, and a wiring board having reduced waving or warping and

which enables formation of a plating film with fewer defects on a wiring pattern can be obtained (page 8, lines 13-21 of the specification). Because the average particle size of the ceramic particle is 100 nm or less, even if the ceramic particle becomes adjacent to or is exposed to the conductor layer surface, the plating property of the conductor layer is not impaired (page 9, lines 15-19 of the specification). Moreover, by setting the average particle size of the ceramic particle to 100 nm or less, waving of the wiring board and deterioration and plating property of the conductor layer is prevented (page 10, lines 8-15 of the specification).

In a second aspect as claimed in claims 8 and 9, in a cross section in a thickness direction of the conductor layer, a total area of the inorganic material having a particle size of 2 μm or more is 5 % or less of the sectional area of the conductor layer (or a total area of the inorganic material having a particle size of 3 μm or more is 2 % or less of the sectional area of the conductor layer).

The wiring board preferably comprises a conductor layer having dispersed therein an inorganic material having an average particle size of 2 μm or less (page 16, line 24-page 17, line 2 of the specification). By specifying that the inorganic material having a particle size of 2 μm or more dispersed in the conductor layer accounts for 5 % or less of the sectional area of the conductor layer, waving of the wiring board and surfacing of inorganic material in the conductor layer is reduced so as to provide a good plating property (page 17, line 25-page 18, line 9 of the specification). Similar results are obtained by limiting inorganic material having a particle size of 3 μm or more dispersed within the conductor layer so as to amount to 2 % or less of the sectional area of the conductor layer (column 18, line 23-column 19, line 7 of the specification).

(ii) Comparison of Invention to Prior Art:

Nakatani et al. teaches a printed circuit board comprising an insulating layer, via holes and a conductive paste containing copper particles, liquid epoxy resin and insulating particles as mentioned by the Examiner.

The invention of present claims 1, 2 and 3 differs from Nakatani et al. in that the present invention requires one of SiO₂ particles having an average particle size of 50 nm or less (i.e., 0.05 μ m or less) and ceramic particles having an average particle size of 100 nm or less (i.e., 0.10 μ m or less), whereas Nakatani et al. calls for insulating particles of an average particle size of 8-20 μ m which is a factor of at least 80 fold greater than that specified by the present invention (Abstract and column 4, lines 63-66). Further in this regard, Nakatani et al. teaches that by adding insulating particles of large particle size, the amount of copper particles to be added is decreased so that a via hole connection of low specific resistance and high reliability is obtained. Other benefits of adding insulating particles of large particle size are said to be a decrease of the viscosity and continuous printability of the paste (Abstract). Moreover, the working examples of Nakatani et al. employ insulating particles of large particle size. See, for example, the example described at column 9 where the conductive paste contained SiO₂ particles of an average particle size of 12 μ m (column 9, lines 36-37). See also Table 2 at column 11 where the insulating particles had a particle size ranging from 10 to 16 μ m.

The Examiner considered that it would have been a "matter of design choice" to select insulating particles having a particle size within the scope of the present claims. However, this would be entirely contrary to what Nakatani et al. teaches, and the Examiner has not explained

what would motivate one of ordinary skill to reduce the average particle size of the insulating particles of Nakatani et al. by 80 fold or more so as to be within the scope of the SiO₂ particle having an average particle size of 50 nm or less as claimed, or a ceramic particle having an average particle size of 100 nm or less as claimed. Moreover, the cited prior art does not teach or suggest the advantages of the present invention in preventing warping of the wiring board, enhancing the plating property and reducing defects.

Claim 8 which requires that a total area of the inorganic material having a particle size of 2 μm is 5 % or less of the sectional area of the conductor layer is not possibly met by Nakatani et al. which requires insulating particles of an average particle size of 8-20 μm in an amount of 0.5-15 % (Abstract). Likewise, Nakatani et al. cannot possibly meet present claim 9 which requires a total area of the inorganic material having a particle size of 3 μm or more to be 2 % or less of the sectional area of the conductor layer.

For the above reasons, it is respectfully submitted that the present claims are patentable over Nakatani et al. in view of Prabhu et al., and withdrawal of the foregoing rejection under 35 U.S.C. § 103(a) is respectfully requested.

Claims 1, 2, 3 and 6-10 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 2, 6 and 15-19 of U.S. Patent No. 6,855,399 to Sumi et al. Although not identical, the Examiner did not consider the conflicting claims to be patentably distinct from one another because they are said to be "structurally and materially the same".

In response, the common Assignee submits herewith a Terminal Disclaimer disclaiming the terminal part of the statutory term of any patent granted on the above-identified application which would extend beyond the expiration date of the full statutory term of U.S. Patent No. 6,855,399, to thereby obviate the foregoing rejection. Withdrawal is respectfully requested.

Withdrawal of all rejections and allowance of claims 1-10 and 15 is earnestly solicited.

In the event that the Examiner believes that it may be helpful to advance the prosecution of this application, the Examiner is invited to contact the undersigned at the local Washington, D.C. telephone number indicated below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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